CLAIMS

1. Equipment for use in the removal of at least one of relatively fine particulates and components from a first substance, using a second substance, the equipment including a static, co-current contacting mixer section having a plurality of stages defining a flow path, with a flow profile, for the first and the second substance, at least one stage being shaped to define a substantially curved flow path section having an effective centre of curvature located to one side of the flow path, an outside surface and an inside surface between the outside surface and the centre of curvature; at least one immediately adjacent stage being shaped to define an oppositely curved flow path section having a centre of curvature on an opposite side of the flow path, an outside surface and an inside surface between the outside surface and the centre of curvature whereby, as the first and second substances flow through the mixer section, the second substance and particles present in the first substance migrate through the first substance, first in one direction relative to a general flow direction and then in a substantially opposite direction to promote interphasic interaction, the flow path characterised in being provided with an edge formation in a region between said adjacent stages so as to enhance launch of the second substance on the outside surface of the curved flow path section of said at least one stage towards the outside surface of the oppositely curved flow path section of the immediately adjacent stage, thus increasing the interphasic interaction.

2. Equipment as claimed in claim 1 wherein the first substance is a gas and the second substance is a scrubbing fluid.

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3. Equipment as claimed in claim 2 wherein the edge formation is stepped, with a substantially perpendicular face relative to the edge formation to enhance the launch of the scrubbing fluid.

4. Equipment as claimed in claim 3 wherein the stepped edge formation is provided with a ledge subsequent to the step to define a first and a second step, the first and the second step being arranged so as to encourage a small back eddy of gas immediately beneath the first step that deflects any downwards dribble of scrubbing fluid around the stepped edge back up into an underside of the main fluid flow as it leaves the first step so as to enhance the contact between the launched fluid and the gas.

5. Equipment as claimed in claim 4 wherein the edge formation defines a fillet radius between the perpendicular face and the ledge to ensure maximum effect from the back eddy.

6. Equipment as claimed in claim 4 or claim 5 wherein the length of the perpendicular face is similar to the length of the ledge.

7. Equipment as claimed in any one of claims 1 to 6 wherein the mixer comprises a plurality of adjacent stages with oppositely curved flow path sections and wherein an edge formation is provided between each of such adjacent stages.

8. Equipment as claimed in claim 7 wherein the flow path is configured and dimensioned to orientate both the angle and the position of each launch with respect to the subsequent shape of the flow profile and to the controlled change

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in direction of the flow profile so as to catch the maximum of the scrubbing fluid that is launched at a landing zone on the opposite side of the flow profile before a subsequent launch so as to enhance the scrubbing effect from the bulk of the scrubbing fluid.

9. Equipment as claimed in claim 8 wherein the flow path has a flow profile that is configured and dimensioned, with a step towards the start of each inside radius, such that the position of launch of effectively the bulk of the scrubbing fluid is towards the beginning of each inside curve so as to enhance the contact between the launched scrubbing fluid and the gas.

10. Equipment as claimed in claim 2 wherein the flow path has a flow profile that is configured and dimensioned such that the scrubbing fluid leaves at the point of launch as a substantially single, flat layer of fluid, thereby ensuring that the minimum of droplets are released within the shadow of droplets that left prior thereto so as to maximize the contact between the launched fluid and the gas.

11. Equipment as claimed in claim 2 wherein the flow path has a flow profile that is configured and dimensioned such that the bulk of the scrubbing fluid reaches the far side of the flow profile before the scrubbing fluid on that side is released at the position of launch towards the beginning of the next bend so as to maximize the contact between the launched scrubbing fluid and the gas.

12. Equipment as claimed in claim 3 wherein the flow path has a flow profile that is configured and dimensioned such that, by the angle of the lead up to that step and the introduction of substantially axially orientated straight sections to the flow profiles, the scrubbing fluid, when reaching the opposite side wall, arrives at an angle of approach which approaches zero degrees so as to maximise the recovery of the energy of the droplets within the surface film and therefore to minimise abrasion at the landing zone.

13. Equipment as claimed in claim 3 wherein the flow path has a flow profile that is configured and dimensioned, by the introduction of substantially axially orientated straight sections to the flow profiles, so that the distance from the landing zone to the subsequent launching point is reduced so as to minimise the subsequent effects of viscous drag on the landing velocity of the fluid.

14. Equipment as claimed in claim 3 wherein the flow path has an increased launch angle of between about 3° and 10° relative to that which is used for the outer annulus.

15. Equipment as claimed in claim 3 wherein the flow path is configured and dimensioned to provide an increased gas velocity down the inner annulus of between about 5 and 25% relative to that down the outer annulus.

16. Equipment as claimed in claim 3 wherein the flow path has a flow profile that is characterised in that the bend that gathers the scrubbing fluid ready for launching into the outer annulus is configured and dimensioned such that the

scrubbing fluid droplet impingement and film velocity on this bend and at the subsequent launch point are no more severe than for that at the equivalent point in the outer annulus.

17. Equipment as claimed in claim 3 wherein the flow path has a flow profile that is configured and dimensioned such that the section of the flow profile leading from each inner annular zone to the respective following outer annular zone optimises recovery of the extra velocity energy in the inner annulus area back to pressure energy at the outer annulus.

18. Equipment as claimed in claim 3 wherein the flow path has a flow profile downstream of the landing zone for the bulk of the droplets wherein the flow area increases substantially steadily and progressively whilst maintaining a relatively constant flow direction and achieving a substantial portion of the flow area of the outer annulus prior to the outer annulus launch point and prior to the associated change in direction of the gas flow.

19. Equipment as claimed in claim 3 wherein the mixer section is characterized in achieving removal efficiencies of above 90% of particle sizes of less than 0.05 micron.

20. Equipment as claimed in claim 2 wherein the gas is waste gas from a modern high-performance Sinter Plant.

21. Equipment as claimed in claim 2 wherein the mixer section is provided with a scrubbing fluid inlet, the scrubbing fluid inlet being configured and dimensioned to create relative adiabatic quenching of the gases.

22. Equipment as claimed in claim 21 wherein the adiabatic quenching of the gases is to a temperature of between 20 and 60°C.

23. Equipment as claimed in claim 22 wherein the adiabatic quenching of the gases is to a temperature of about 30 to 50°C.

24. Equipment as claimed in claim 2 wherein the scrubbing fluid inlet is arranged such that the bulk of the scrubbing fluid retains a large droplet form and a low launch velocity relative to the droplet sizes and launch velocities in the subsequent stages in the mixer section.

25. Equipment as claimed in claim 2 including a cyclonic section for the separation of the gas and the scrubbing fluid.

26. Equipment as claimed in claim 25 wherein the cyclonic section fits substantially within the same cylindrical profile as that of the mixer section.

27. Equipment as claimed in claim 26 wherein the outlet for the scrubbing fluid is connected in an axial direction and substantially within the same overall cylindrical profile.

28. Equipment as claimed in claim 25 wherein the cyclonic section is provided with an exit end in the form of a vortex finder configured and dimensioned to duct away the main vortex of the substantially scrubbing fluid free gas while gathering the substantially gas free scrubbing fluid off the wall of the cyclonic section.

29. Equipment as claimed in claim 25 characterized in having a cyclonic section of predetermined length in order to retain the radial velocity component of the gas flow within the cyclone body within a range required to get the required degree of separation of scrubbing fluid droplets prior to discharging the gas.

30. Equipment as claimed in claim 29 wherein the distance between the spinner section and the top of the vortex finder is about 5 to 10 times the diameter of the cyclonic section.

31. Equipment as claimed in claim 30 wherein the cyclonic section has a length of about 1.5 to 2.5 metres and a diameter of about 0.1 to 0.5 metres.

32. Equipment as claimed in claim 31 wherein the cyclonic section has a length of about 2 metres and a diameter of about 0.3 metres.

33. Equipment as claimed in claim 2 including a spinner section, having a set of angled blades for imparting a circulatory motion to the gas and scrubbing fluid mixture prior to entry of the cyclonic section.

34. Equipment as claimed in claim 33 wherein the width of the flow path through the spinner section is increased radially so that the cross sectional area for the flow is maintained relatively constant as the flow direction changes, thus retaining relative exit velocities of the gas and the scrubbing fluid substantially similar to the respective entry velocities.

35. Equipment as claimed in claim 33 wherein the spinner section is configured and dimensioned so that any object that can pass through the main mixer section can also pass through the spinner section.

36. Equipment as claimed in claim 33 wherein the spinner section is provided with an annulus through which the gases and scrubbing fluid flow so as to calm the bulk of any residual turbulence from the spinner blades.

37. Equipment as claimed in claim 36 wherein the annulus has an inner, substantially hollow profile with a cylindrical recess with a suitably shaped inner end in order to remove droplets of scrubbing fluid that contaminate the scrubbed and cycloned product gases.

38. Equipment as claimed in claim 3 including a centrally orientated, discharge pipe relatively to the vortex finder, with a diameter of about 70 to 90 % of that of the vortex finder outlet, providing an annular gap there between.

39. Equipment as claimed in claim 38 wherein the annular gap is configured and dimensioned to pass debris that could access the equipment and wider than the typical maximum splash and spray layer that would accompany the scrubbing fluid as it runs down the inner walls of the cyclonic section.

40. Equipment as claimed in claim 33 wherein the gap is configured and dimensioned so that the minimum width of the annular gap at the vortex finder is based on the concept of capturing all the splash and spray into this annular area.

41. Equipment as claimed in claim 33 wherein the mixer section, the spinner section and the cyclonic section are cast in a single, substantially integral unit.

42. A method for the removal of at least one of relatively fine particulates and components from a first substance, using a second substance, the method including the steps of transporting the first substance and the second substance through a plurality of stages defining a flow path, at least one of the stages being shaped to define a substantially curved flow path section having an effective centre of curvature located to one side of the flow path, an outside surface and an inside surface between the outside surface and the centre of curvature; at least one immediately adjacent stage being shaped to define an oppositely curved flow path section having a centre of curvature on an opposite side of the flow path, an outside surface and an inside surface between the outside surface and the centre of curvature, whereby as the first substance and the second substance flow through the flow path the second

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substance and particles present in the first substance migrate through the first substance, first in one direction and then in a substantially opposite direction to promote interphasic interaction; and utilizing a launch formation between the adjacent stages for launching the second substance on the outside surface of the curved flow path section of the at least one stage to the outside surface of the curved flow path section of the immediately adjacent stage, to increase the interphasic interaction.

43. A method as claimed in claim 42 wherein the first substance is a gas and the second substance is a scrubbing fluid.

44. A method as claimed in claim 42 characterized in achieving removal efficiencies of above 90% of particle sizes of less than 0.05 micron.

45. A method as claimed in claim 43 characterized in being suitable for scrubbing waste gas from a modern high-performance Sinter Plant, using a suitable scrubbing fluid.

46. A method as claimed in claim 43 including the step of adding a relatively fine dust upstream of the mixer section to enhance the removal of vapours in the gas.

47. A method as claimed in claim 46 wherein the fine dust is pre-selected so as to enhance the chemisorbtion on to the dust of gasses and vapours selected from the group consisting of dibenzo furan, PCB, related compounds and any combinations thereof.

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48. A plastics composite material comprising a resin and a plurality of silicon carbide (SiC) particles embedded in the resin, the particles being bonded to the resin using a silane based bonding mechanism and the particles falling into at least first and second separate and distinct size groups and wherein the particles of the first size group are dimensionally at least 7.5 times larger than the particles of the second size group.

49. A process for producing a composite material, the process comprising the steps of:

i. providing at least first and second separate and distinct size groups of particles of silicon carbide (SiC), the particles of the first size group being dimensionally at least 7.5 times larger than the particles of the second size group;

ii. pre-treating the particles with a silane solution; and

iii. mixing and bonding the pre-treated particles with a resin, thereby to form an abrasion, impact and temperature resistant composite mixture.

50. A process as claimed in claim 49 wherein a third separate and distinct size group of particles of silicon carbide is provided and wherein particles of the second size group are larger than the particles of the third size group.

51. A process as claimed in any of claims 49 to 50 wherein the size groups of particles are provided separately.

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52. A process as claimed in any of claims 49 to 51 wherein an amount of silane used in said solution for the pre-treatment of the particles within each size group is selected so as to a substantially maximise the strength properties of the composite relative to that which can be ultimately achieved using silane pre-treatment and that specific formulation of solids and resin.

53. A process as claimed in any of claims 50 to 52 wherein a ratio of dimensional sizes between particles of the second size group and particles of the third size group is in excess of 8:1.

54. A process as claimed in any of claims 49 to 53 wherein the particles of the first size group and the particles of the second size group are provided by particles with a designated size of 10 mesh and 60 mesh respectively.

55. A process as claimed in any one of claims 49 to 54 wherein the resin is selected from a group consisting of: a vinyl ester resin, a polyurethane resin, and a combination of a vinyl ester resin and a polyurethane resin.

56. A process as claimed in any one of claims 49 to 55 which comprises the step of adding hollow or sponge-like fine particles to the composite mixture, so as to impart elasticity and sponginess to the material.

57. A process as claimed in claim 56 wherein said fine particles are selected from a group consisting of: hollow glass spheres, hollow or sponge like kaolin particles, and a combination thereof.

58. A material that is produced by a process according to any one of claims 49 to 57.

59. Equipment for use in the removal of at least one of relatively fine particles and components from a first substance, using a second substance, the equipment comprising:

- a mixer section;
- a spinner section
- a cyclonic section;
- a vortex finder; and
- an outlet section for the second substance,

wherein at least part of at least one of the mixer section, the spinner section, the cyclonic section, the vortex finder and the outlet section is made of a material as claimed in any of claims 48 and 58.

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